

CLAIMS

We claim:

5

1. A method for optimizing pricing and capacity for bandwidth management using a computer, comprising the steps of:

 inputting a mean and a variance of real usage for each of a plurality of customer classes;

 inputting price and demand curve data which determines an arrival rate for each customer class;

 inputting a number of existing customers in each customer class;

 inputting a bandwidth wholesale cost;

 generate a computer model for an optimization problem subject to a plurality of predetermined chance constraints;

 solving said optimization problem using said computer to determine an amount of bandwidth to be purchased in a time period at a given price for an expected number of new customers in order to maximize profit; and

 outputting said amount of bandwidth to be purchased and said expected number of new customers.

2. A method for optimizing pricing and capacity for

bandwidth management using a computer as recited in claim 1 wherein said plurality of predetermined chance constraints comprises:

$$b_\tau = b_{\tau-1} + a_\tau \quad (\tau = 1, \dots, T) \quad (1)$$

$$L_{i\tau} \leq q_{i\tau} \leq U_{i\tau} \quad (i = 1, \dots, I; \tau = 1, \dots, T) \quad (2)$$

$$\begin{aligned} & \sum_{i|\tau < d_i} [\lambda_{i\tau} \Delta \mu_i^2 + (n_{i\tau} + \lambda_{i\tau} \Delta)^2 \sigma_i^2 + (n_{i\tau} + \lambda_{i\tau} \Delta)^2 \mu_i^2] \\ & + \sum_{i|\tau \geq d_i} [\lambda_i D_i (\mu_i^2 + \sigma_i^2) + (\lambda_i D_i \mu_i)^2] - \delta_\tau b_\tau^2 \leq 0 \quad \forall \tau \end{aligned} \quad (3)$$

and said optimization problem comprises:

$$\text{Maximize} \quad \sum_{i,\tau} q_{i\tau} \lambda_i (q_{i\tau}) - \sum_\tau c_\tau a_\tau \quad (4)$$

wherein:

$i = 1, \dots, I$: customer class;
 $\tau = 1, \dots, T$: time periods, each of length Δ ;
 δ_τ is tolerance on capacity violation in period τ ;

C_τ is cost per unit of buying new capacity in period τ ;

d_i is duration of contract for customer class i ;

D_i is actual duration of contract ($d_i\Delta$) for customer class i ;

$n_{i\tau}$ is a number of existing contracts of type i still active at start of period τ ;

$L_{i\tau}$ is a lower bound on contract price;

$U_{i\tau}$ is an upper bound on contract price;

b_τ is bandwidth available in period τ ;

a_τ is bandwidth purchased by re-seller in period τ ;

$q_{i\tau}$ is price to new or renewing customers for a new standard length contract of type i in period τ ; and

$\lambda_i(q_{i\tau})$ is expected number of new customers of type i arriving in any period if a price for a contract is set at $q_{i\tau}$.

3. A method for optimizing pricing and capacity for bandwidth management using a computer as recited in claim 1 wherein said computer solving and optimization problem is running a non-linear programming software.

4. A computer readable medium comprising software for causing a computer to execute steps for optimizing pricing and capacity for bandwidth management, comprising the steps of:

receiving a mean and a variance of real usage for

PAGES 4 DELETED

each of a plurality of customer classes;
receiving price and demand curve data which determines an arrival rate for each customer class;
receiving a number of existing customers in each customer class;
receiving a bandwidth wholesale cost;
generating a computer model for an optimization problem subject to a plurality of predetermined chance constraints;
solving said optimization problem using said computer to determine an amount of bandwidth to be purchased in a time period at a given price for an expected number of new customers in order to maximize profit; and
outputting said amount of bandwidth to be purchased and said expected number of new customers.

5. A computer readable medium comprising software for causing a computer to execute steps for optimizing pricing and capacity for bandwidth management as recited in claim 4 wherein said plurality of predetermined chance constraints comprises:

$$b_{\tau} = b_{\tau-1} + a_{\tau} \quad (\tau = 1, \dots, T) \quad (1)$$

$$L_{i\tau} \leq q_{i\tau} \leq U_{i\tau} \quad (i = 1, \dots, I; \tau = 1, \dots, T) \quad (2)$$

and said optimization problem comprises:

wherein:

$$\begin{aligned} & \sum_{i|\tau < d_i} [\lambda_{i\tau} \Delta \mu_i^2 + (n_{i\tau} + \lambda_{i\tau} \Delta)^2 \sigma_i^2 + (n_{i\tau} + \lambda_{i\tau} \Delta)^2 \mu_i^2] \\ & + \sum_{i|\tau \geq d_i} [\lambda_i D_i (\mu_i^2 + \sigma_i^2) + (\lambda_i D_i \mu_i)^2] - \delta_\tau b_\tau^2 \leq 0 \quad \forall \tau \end{aligned} \quad (3)$$

$$\text{Maximize} \quad \sum_{i,\tau} q_{i\tau} \lambda_i (q_{i\tau}) - \sum_{\tau} c_{\tau} a_{\tau} \quad (4)$$

$i = 1, \dots, I$: customer class;

$\tau = 1, \dots, T$: time periods, each of length Δ ;

δ_τ is tolerance on capacity violation in period τ ;

c_{τ} is cost per unit of buying new capacity in period τ ;

d_i is duration of contract for customer class i ;

D_i is actual duration of contract ($d_i \Delta$) for customer class i ;

$n_{i\tau}$ is number of existing contracts of type i still active at start of period τ ;

$L_{i\tau}$ is a lower bound on contract price;

U_{it} is an upper bound on contract price;

b_τ is bandwidth available in period τ ;

a_t is bandwidth purchased by re-seller in period t

q_{it} is price to new or renewing customers for a new standard length contract of type i in period τ ; and

$\lambda_i(q_{it})$ is expected number of new customers of type i arriving in any period if a price for a contract is set at q_{it} .

6. A computer readable medium comprising software for causing a computer to execute steps for optimizing pricing and capacity for bandwidth management as recited in claim 4 wherein said computer solving and optimization problem is running a non-linear programming software.